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PLANT PROTECTION

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SCIENCE IN PRACTICE

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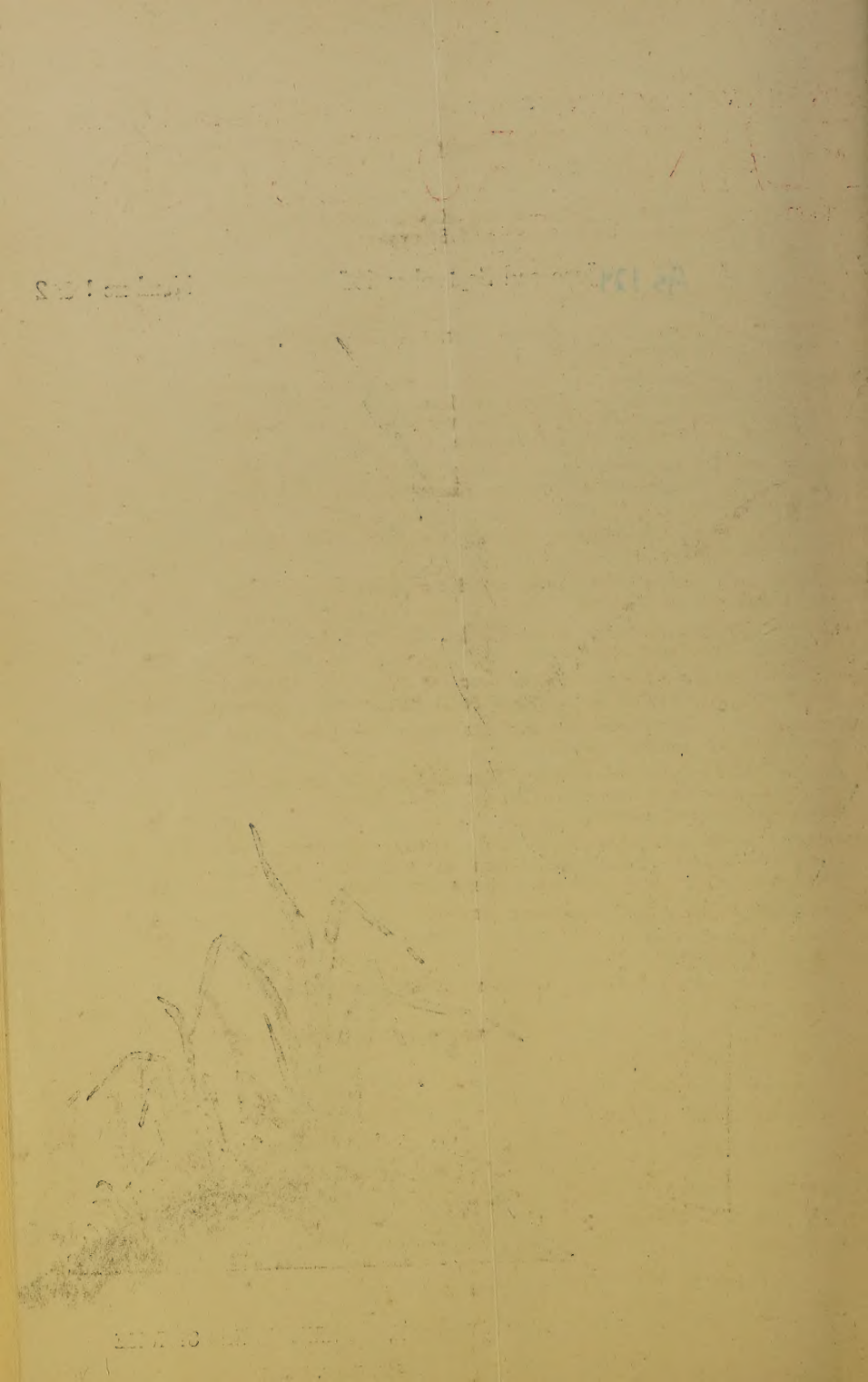

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COVER ILLUSTRATION :

PHADKA

Showing the damage it does and its egg-pods laid at the base of bushes.

L12DPPQ&S

NOTE

The object of this Bulletin is to present a factual and integrated picture of the plant pests and diseases situation in India and measures adopted to protect crops from their ravages. Any suggestions for the improvement of this Bulletin will be gratefully received.

HEM SINGH PRUTHI,

Plant Protection Adviser to the Government of India.

PLANT PROTECTION WORK IN INDIA DURING KHARIF, 1949

(a) Insect Pests

Plant protection work on organised lines in India is yet in its infancy. With the help of this Directorate several States have made a good start. In several others, e.g. Assam, Punjab, Rajasthan, Union of Travancore and Cochin, Mysore and Bihar, such schemes are awaiting the sanction of the respective governments. Even as it is, the control operations in many of the States, have resulted in measureable savings from the depredation of the pests. Below is the gist of the achievements of the various States in this respect, pertaining to the Kharif season of 1949.

Delhi

The State Plant Protection Organisation is not yet well equipped. In many cases, therefore, the Plant Protection Directorate of the Central Government undertook control operations against various insect pests of crops and vegetables. The Singhara beetle (*Galerucella birmanica*) was very severe on *Singhara* (*Trapa bispinosa*). About 70 acres of the crop were dusted with 5 per cent. BHC or 10 per cent DDT. The saving is estimated at Rs. 30,000 at a cost of Rs. 175 only.

Ajmer

About 40,000 acres of millets infested with Phadka grasshopper (*Hieroglyphus nigrorepletus*) were successfully dusted with 5-10 per cent BHC. The gain is estimated as 1,25,000 mds. of grain and 1,00,000 cart loads of fodder, equivalent to Rs. 37,50,000.

Coorg

About 3,000 acres of paddy infested with *Leptispa* sp. were treated with BHC, the estimated increase in yield being about 500 tons. Control operations against other paddy pests (Case-worm, hairy caterpillar, grasshoppers, etc.) were also undertaken and it is estimated that about 1,500 tons of paddy were saved.

Madras

About 10,000 acres of paddy infested with *Spodoptera mauritia* were dusted with Gammexane D025, Guesarol 405 or sprayed with Guesarol 550 and complete control was obtained. Paddy infested with *Leptispa pygmaea* and *Tetroda histeroides* on 115 and 67 acres respectively, was dusted with Gammexane D025, resulting in almost complete control. *Hispa armigera* and *Nymphula depunctalis* in 734 and 717 acres respectively were eradicated by Gammexane D025 dusting or collection by hand nets, etc. As the result of control operations against the various insect pests of paddy, the estimated increase in yield was 1,66,619 tons. About 6,27,000 acres were baited

with 1 per cent Zinc phosphide and rat menace was reduced by 95 per cent, the estimated gain being 1,73,000 tons of paddy. About 8,000 acres of paddy, sugarcane and millets infested with *Hieroglyphus* sp. were almost cleared of the pest by dusting with Gammexane D025 and 5,000 acres by passing tarred sheets over the infested area, the estimated gain being about three lakhs of rupees. About 100 acres of millets infested by *Calocoris angustatus* were dusted with Gammexane D025, the estimated gain being about Rs. 2,000. Fish oil rosin soap was sprayed on 160 citrus trees infested with aphids and were completely cleared of the pest, estimated gain being Rs. 16,000. *Papilio demoleus* in 7 acres was completely controlled by spraying calcium arsenate. The attack of *Gnorimoschema operculella* in 4 acres was reduced by 50-60 per cent by spraying with Guesarol 550, the estimated gain being Rs. 150. Dusting against cut worms was done over 23 acres, resulting in the saving of 15 tons of potatoes.

Union of Travancore and Cochin

About 1,300 acres of paddy infested by *Hispa armigera* were dusted or sprayed with Gammexane or DDT, resulting in reduction of attack by 25-90 per cent. *Spodoptera mauritia* infesting paddy was completely controlled by dusting with DDT.

Mysore

The paddy in an area of 15,000 acres was so heavily infested with grasshoppers, that the entire crop was threatened but was saved by timely dusting with BHC. Jola (Sorghum) crop was dusted with BHC against Jola ear bug (*Calocoris angustatus*) on 125 acres and against *Colemania* on 4,453 acres. Control operations were also undertaken against *Sesamia inferens*, infesting about 2,000 acres of *ragi* crop.

Bombay

Grasshoppers were the most prominent pests in the province. About 23,000 acres of paddy infested with the Rice grasshopper (*Hieroglyphus banian*) were dusted with 5 per cent BHC. The infestation was milder in 1949 due to control in the previous year. Control operations against the same pest infesting sugarcane were undertaken on 2,282 acres. Against the Deccan wingless grasshopper (*Colemania sphenarioides*) infesting millets, BHC (7-10 per cent) dusting was done on 53,624 acres. About 580 hand-dusting machines were in use. About 200 acres of paddy infested by *Leptispa* were also treated by BHC. Peas (200 acres) infested with aphids were treated with DDT, BHC or fish oil rosin soap. A beetle grub damaging paddy, *jowar* and *bajra* over 600 acres was controlled by mechanical means. *Bajra* seed for sowing over 26,500 acres was treated with BHC.

In Baroda, under the Pest Control Act, Cotton Stalks infested with *Earias fabia* were removed from 2,23,550 acres, the estimated gain of 'Kapas' in the following season being Rs. 30 lakhs. Jowar stubbles infested with *Chilo zonellus* were also removed from 100 acres. Mango trees, numbering 2,000 and infested by *Idiocerus* sp. were dusted with sulphur or Gammexane D025, estimated gain being Rs. 24,000.

Assam

Bagging and light traps were extensively used against *Nymphula depunctalis, Leptocorisa acuta, Schoenobius bipunctifer* and *Hieroglyphus banian* infesting paddy fields. In over 270 acres Gammexane D025 was effectively dusted against these pests as well as against *Hispa armigera* and *Spodoptera mauritia,* estimated gain being Rs. 51,400.

West Bengal

About 10,300 acres of paddy infested with *Leptocorisa* sp. and *Spodoptera mauritia* were treated with BHC estimated gain being Rs. 78,000. Potato crop infested with *Epilachna* sp. and aphids over 1,000 acres was sprayed with 0.1 per cent DDT and a loss of 5,000 maunds of potato was prevented. Stored potato weighing 3,270 maunds were also treated with Gammexane D025 against potato tuber moth (*Gnorimoschema operculella*).

Bihar

Twenty acres of maize crop infested by *Chilo zonellus, Sesamia inferens* and *Marasmia trapezalis* were dusted with 3 per cent DDT, 2.5 per cent Hexyclan or 3 per cent Gammexane. The reduction in attack was 60-80 per cent the cost per acre being only Rs. two to Rs. five. Fifty acres of paddy crop infested by *Pachydiplosis oryzae* were cleared of the pest by the removal of the affected shoots. Control by dusting with BHC or spraying with DDT over 105 acres of paddy infested by *Hispa* sp. and *Nymphula depunctalis* were also undertaken.

Uttar Pradesh

Sugarcane and jowar fields infested by *Hieroglyphus* sp. and other grasshoppers in 366 acres were dusted with 5 per cent BHC or baited with Sodium fluosilicate, resulting in a reduction of attack by 50-90 per cent. Dusting with 5 per cent BHC or bag netting over 411 acres of paddy infested with *Hieroglyphus banian* and *Leptocorisa acuta* gave 75-100 per cent results. About 1,100 pear and apple trees infested with *Eriosoma lanigerum* were sprayed with tobacco decoction or fish oil rosin soap, and 459 trees infested with apple stem borer were treated with Chloroform creosote. About 300 citrus trees infested with *Papilio demoleus* were sprayed with lead arsenate with 100 per cent success. 784 and 384 citrus trees infested with citrus white fly and leaf miner respectively were sprayed with lime sulphur wash in the case of the former and tobacco decoction in the case of the latter, resulting in 60-70 per cent reduction in attack. Good results were obtained by spraying 0.25 per cent DDT on 67 grafted mangoes infested with *Idiocerus* sp. Sixty-four guava trees infested with Curculionid beetles were sprayed with DDT and in 25 trees holes made by *Inderbela tetraonis* were fumigated with petrol. Seventeen stores of potatoes infested by *Gnorimoschema operculella* were dusted with Gammexane D025. Field rats were fumigated in or baited at 3,911 burrows.

East Punjab

Sixty-four acres of paddy dusted with Gammexane or sprayed with Agrocide reduced the attack of surface grasshoppers by 80-90 per cent whereas the attack of *Hispa armigera* infesting 3 acres was reduced by 95 per cent by dusting with BHC. Infestation of sugarcane borers (*Argyria sticticraspis and Scirpophaga nivella*) was reduced by 95 per cent in 302 acres by spike thrust method and in 61 acres by removal of affected shoots. Surface grasshoppers infesting 350 acres of millets were controlled by baiting or dusting. Miscellaneous crops infested by *Amsacta moorei* were dusted with BHC or sprayed with 0.1 per cent Agrocide, resulting in 95 per cent reduction in attack. Infestation of *Chrotogonus* in 285 acres of cotton was reduced by 75 per cent by using Sodium fluosilicate bait or BHC dust. About 8 acres of cotton field were dusted with lead-arsenate or DDT against *Sylepta derogata.* About 5,000 apple trees infested with stem borer were treated with potassium cyanide, the reduction in attack being 90-100 per cent. Attack of citrus psylla on 280 citrus trees was reduced by 90 per cent by spraying with rosin compound and of *Papilio demoleus* on 896 trees by 95 per cent by spraying lead arsenate ; 0.1 per cent DDT spraying against *Dialeurodes citri* on 300 trees reduced the attack by 100 per cent. About 22,000 nursery plants were treated with 3 per cent sanitary fluid and it gave 80 per cent reduction in white-ant attack. Baits of strychnine hydro-chloride or zinc phosphide were laid for rats over an area of about three lakh acres. Five hundred jackals were also killed by poison baiting. Grain stored in about forty thousand cubic ft. was fumigated against stored grain pests.

Rajasthan

About 3,500 acres of Kharif crop infested with *Hieroglyphus nigrorepletus* in Udaipur and Kishangarh States were saved by dusting with 7-10 per cent BHC.

(b) Plant Diseases

Delhi

Jowar seeds to cover about 7,500 acres were treated with Agrosan GN against Smuts (*Sphacelotheca sorghi* and *S. cruenta*). The crops raised from treated seeds showed better stands and gave higher yields of fodder and grain.

Ajmer

Jowar seeds to sow about 3,000 acres were treated in small lots for individual cultivators in different villages of Ajmer-Merwara for the control of the common Smut diseases. The crops raised from treated seed showed complete absence of the disease and gave higher yields of fodder and grain.

Coorg

Paddy seeds sufficient to cover 15,658 acres were treated with Agrosan GN against general fungoid diseases, resulting in an estimated gain in yield of about 8,600 mds. of paddy.

Leaf fall, Fruit rot and Mildew were widespread on orange plantations. Spraying with Bordeaux mixture against the former and dusting with sulphur against the latter were undertaken. During the Kharif season, 2,957 acres of orange trees were thus treated. In addition, 966 acres of Coffee and 110 acres of Arecanut were treated against Leaf rot and 'Mahali' (*Phytophthora arecae*), respectively.

Madras

Paddy seeds sufficient for 15,780 acres were treated against Foot-rot and Seedling blight. About 786 acres of paddy seedlings were sprayed for the control of Blast disease. These treatments were estimated to give an additional yield of over 23,066 maunds of paddy. Furthermore, paddy seeds of Blast resistant varieties such as Co. 4, Co. 25 & Co. 26 were distributed over an area of 40,000 acres.

Sorghum seeds for an area of 61,355 acres were treated for the control of the common Smut disease. This treatment was estimated to give an increased yield of over 9,000 maunds of grain.

About 45,110 trees of citrus were sprayed against Canker, Die-back and Mottle-leaf. Roguing operations were carried out over 72 acres of sugarcane against Red rot and Smut diseases. About 250 acres of vegetable crops were treated against different diseases such as Mildew, Leaf spots, Damping off and Fruit rot.

Bombay

Paddy crop over an area of 2,955 acres was treated against Blast disease which is estimated to cause a loss of 25-45 per cent in this State. The treatment which included spraying the seedlings with Bordeaux mixture and application of manure mixture, brought about a reduction of 25-40 per cent in the intensity of the disease.

Pre-sowing treatment of jowar seed for the prevention of Smut diseases was adopted as a routine practice by most cultivators all over the State during this season. Seeds for over 10,00,000 acres were treated with sulphur and an additional yield of 1,40,000 maunds of grain was estimated as a result of this treatment.

Assam

Late-blight of potato which broke out in Khasi and Jaintia hills, threatened serious damage to the crop. Large scale spraying of plants with Perenox was carried out in the cultivators' fields to prevent the spread of the disease.

In citrus, Scab, Canker and Wither-tip were found widespread and quite severe in orchards in Ranibari and Burnihat tracts, where 1,200 trees were sprayed with Perenox and the diseases appreciably checked.

West Bengal

As a preventive against seedling infection of *Helminthosporium oryzae*, 25,000 mds. of paddy seeds to cover 75,000 acres were treated. The *Helminthosporium* disease is widespread in this State and it is proposed to treat much larger areas during the next season to control the seedling phase when the disease is most destructive. The Algal weed (*Chara*) which was very severe in low lying *Aman* paddy fields was completely controlled over an area of 5,000 acres of paddy by the application of copper sulphate @ 8-12 lbs. per acre with 3-4 times the quantity of ammonium sulphate. An additional yield of 15,000 maunds of paddy was expected as a result of this treatment.

Over 900 acres of potato crop in Darjeeling district were sprayed with Perenox & Dithane D-14 against Late blight which appears in an epidemic form in these hills every year. As a result of spraying, an additional yield of 10-20 maunds of potatoes per acre was estimated.

In addition to the above, sprayings were conducted over an area of 20 acres of Betelvine for the control of *Phytophthora* leaf damage and 77 acres of 'Patal' (*Trichosanthes indica*) for the control of Downy mildew (*Pseudoperonospora cubense*) and Fruit rot (*Pythium aphanidermatum*).

Punjab

Control operations against citrus Canker and Wither-tip were carried out and a total of 4,533 trees and 51,000 plants of Citrus were sprayed during the Kharif season. These diseases which usually appear in a moderately intense form in the State were appreciably checked as a result of the treatment.

In addition, 400 plants of peach were sprayed against Leaf curl.

U.P.

Jowar seeds to cover about 3,912 acres were treated with Agrosan GN against Smut. As a preventive measure against fresh infections of Stem black (*Coniothecium chomatosporum*), Stem brown (*Botryosphaeria ribis*), Pink disease (*Corticium salmonicolor*) & Collar rot (*Rosellinia* sp.), 3,203 apple trees were treated with Chaubattia paste after a judicious pruning of the affected branches. Also 2,898 trees of mango were treated against Die-back and Bunchy top. As a measure against the spread of Red-rot rogueing operations were carried out over an area of about 223 acres of sugarcane.

PROGRESS OF THE WHEAT RUST CONTROL WORK IN PENINSULAR AND CENTRAL INDIA DURING 1949-50

The cultivation of wheat and barley from the first of April to the thirtieth of September was prohibited in the States of Madras, Bombay, Mysore and Union of Cochin and Travancore. The ban had been enforced for a period of three years as an experimental measure in 1948.

In the summer of 1949, the second year of its operation, the staff of the Plant Protection Directorate periodically surveyed the different localities between May and August to see how effectively the ban was enforced.

In May, the Plant Protection Adviser personally inspected the most important areas in the Nilgiris where wheat and barley used to be cultivated during summer. He observed that no wheat or barley crop was grown, instead ragi, potatoes, onions and garlic were raised. He, however, detected some self-sown wheat plants about 6-9" tall, which matter was brought to the notice of the Deputy Director of Agriculture, Coimbatore, who had them eradicated. Later an Assistant from the Directorate extensively toured over the Nilgiris, the Palnis, and the Devikulam taluqa in the Travancore State. No wheat or barley crop was grown in any of the localities. The State authorities had given wide publicity of the ban and had taken necessary measures to enforce it.

Later, in July and August, an Assistant Mycologist, toured in the Madras and the Mysore States and two Assistants were sent on tour in Bombay.

Madras

Most of important areas where wheat and barley used to be grown were surveyed. This included, the Nilgiris and the Palnis, and the ceded districts of Bellary and Anantapur. No wheat or barley crops were raised. Instead, various millets, viz. ragi, *same*, tenai, and Keere (*Amaranthus*) and vegetables viz., potatoes, onions, and garlic were sown in the hills. In the plains, at Bellary and Anantapur, there is usually a small area under the wheat crop in summer, but even that was not sown this year.

Mysore

In the Mysore State, inspite of the best efforts of the Director of Agriculture, some wheat was grown by the farmers in the Chitaldroog, Chikmagalur and Hassan districts, but the area was much smaller this year. In all the three districts the total area under wheat was about 400 acres. It had been sown in June and July, and was mostly in the seedling stage when this area was visited. Since this was in contravention of the ban, the matter was brought to the notice of the Mysore Government and the entire crop destroyed, sometimes with police help. It was fortunate that no rust was observed on these crops at this time.

A small plot of 2-3 acres which escaped the notice of the local authorities and was later detected by the staff of this Directorate got lightly infected with black rust. This was sown sometime between August and September and in October-November it was in the hard dough stage. The State authorities were informed about it and they got it immediately destroyed.

Bombay

About 10-12 acres of wheat were sown in districts of Satara, Belgaum and Dharwar. This was brought to the notice of the district authorities, and the crops were soon harrowed up.

Considerable success was thus achieved in 1949 in enforcing the ban and this could only be possible with the co-operation of the Provincial and State authorities.

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A SURVEY OF THE PARASITES AND PREDATORS OF THE CITRUS BLACKFLY (ALEUROCANTHUS WOGLUMI ASH.) IN INDIA

By Herbert D. Smith,

Entomologist, Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture, Washington, D.C.

The following regions of India have been surveyed during January-March, 1950 with results as follows :—

Dehra Dun.—Only a few scattered citrus trees were found here. Both *Aleurocanthus woglumi* and *A. husaini* were present in small numbers, with *A. woglumi* being more common. Parasites encountered were *Prospaltella clypealis* and *Prospaltella* sp. (Probably a new species), on *A. woglumi.*

Saharanpur.—Both *A. woglumi* and *A. husaini* were found here with *A. husaini* having the greater infestation. Both the insects appear to be controlled by parasites here. *A. husaini* was found in large numbers on leechi trees in some gardens and also on pear trees in small numbers. The parasites reared in order of importance were: (on *A. woglumi*) *Prospaltella* sp. (as above), *Amitus hesperidum*, *Prospaltella clypealis*, and *Eretmocerus serious*; (on *A. husaini*) *Prospaltella* sp. near *citrofila* and *Eretmocerus serious.*

Ludhiana.—(Collection by Mr. Butani). Only *A. husaini* was found here, in small numbers. Parasitization was rather low by the two species mentioned above.

Bareilly.—Only *A. husaini* was found here and in extremely small numbers, much less than 1 per cent. Parasitization was similar to that at Saharanpur.

Delhi.—Both species were found here but *A. husaini* was much more common. *A. woglumi* infestation was much less than 1 per cent. The parasites of *A. husaini* were the same as at Saharanpur. Only a few clusters of *A. woglumi* were found and these showed parasitization the same as at Saharanpur.

Anand, near Ahmedabad.—Only *A. husaini* found here. Infestation rather heavy. No parasites were reared from the material and no pupae had parasite emergence holes.

Bombay.—*A. woglumi*, *A. husaini* and *A. spiniferus* were found here. *A. woglumi* was heavily parasitized (80 per cent) by *P. clypealis* and *Amitus hesperidum.* A predator, *Acletoxenus* sp. (Drosophilid) was very common on *A. woglumi* and *A. spiniferus. A. husaini* had much less infestation than *A. woglumi* and occurred only on widely scattered trees. *A. spiniferus* was found almost entirely on roses where it often had a heavy infestation, up to 75 per cent. *Prospaltella smithi* was the dominant parasite on *A. spiniferus.* It was also found in small numbers (less than 1 per cent) on *A. woglumi.* An *Aleurocanthus* sp. was found in fair numbers on *Anona squamosa.* This insect was attacked by an *Eretmocerus* sp. to about 50 per cent.

Agra.—Only *A. husaini* was found here and in fair numbers, 50 per cent of leaves attacked. The infestation was heavier than at Delhi and Saharanpur. The material was parasitized by an *Eretmocerus* sp. to about 50 per cent.

Poona.—*A. woglumi* was found in fair numbers almost everywhere here but not enough to cause any damage. Overall infestation was about 10 per cent. The insect was controlled here almost entirely by one parasite P. *clypealis,* which had from 80 to 90 per cent parasitization. Other parasites were : *Amitus hesperidum,* and P. *smithi,* 1 per cent each. The *Acletoxenus* predator was present here in fair numbers. *A. husaini* was found in fair numbers (50-70 per cent) on some pomelos and limes. It was attacked by one parasite only, *Prospaltella* sp. near *citrofila.*

Puntamba, Kopargaon.—A very large irrigated citrus region. *A. woglumi* and *A. husaini* were found here with some damage, mainly by *A. husaini,* in parts of some groves. Most groves had a moderate infestation with no damage. Some groves had practically no infestation. In two large plantings, the two species had a combined infestation of about 90 per cent with the leaves black with sooty mold and the blackfly pupae. This was caused by 30 per cent *A. woglumi* and 60 per cent *A. husaini.* There was only one parasite seen on the *A. husaini,* the *Prospaltella* sp. *A. woglumi* was parasitized by the same parasites as at Poona but to a lesser extent in the heavily infested groves.

Nagpur, Katol.—Only *A. husaini* was found here. An extremely light infestation occurred at Nagpur, much less than one per cent. At Katol one grove had 95 per cent. infestation with all the leaves black. Nearby groves had about one per cent. Only the *Prospaltella* sp. was found here on *A. husaini.* Parasitization by this species was from 60 to 70 per cent in all groves except the heavily infested one where it was about 30 per cent.

Burhanpur, C.P.—Only *A. husaini* was found here. Infestation was about one per cent. Parasitization was the same as at Nagpur.

Bangalore.—*A. woglumi* and *A. spiniferus* were found here, with *A. spiniferus* only on roses. Infestation was very light, less than five per cent. Parasites of *A. woglumi* were *P. clypealis* and *Amitus hesperidum,* combined, showing about 80 per cent parasitization. *P. smithi* occurred on *A. spiniferus* as did also the predator *Acletoxenus* sp.

Hyderabad, Raichur.—No *Aleurocanthus* species were found here on citrus.

Coorg.—No *Aleurocanthus* species were found here on citrus.

Madras.—Only *A. woglumi* was found here. Infestation was very irregular and very light. *P. clypealis* was the only parasite found. Parasitization was over 80 per cent. No *Aleurocanthus* species was reported from the Nilgiri Hills by Mr. Rao who surveyed Madras with me. Also no *Aleurocanthus* species was found on citrus in the large plantings near Kodur.

Calcutta.—*A. woglumi* was almost non-existent here. I found one cluster in one day's survey.

Gauhati, Assam.—*A. woglumi* was found in small numbers here, less than 1 per cent. Parasitization was from 80-90 per cent by : *Prospaltella divergens, Encarsia merceti, Eretmocerus serious, Amitus hesperidum* and *P. clypealis.* The first two accounted for about 90 per cent of the parasitization. *A. husaini* was also found here but much less than *A. woglumi.*

Jorhat.—*A. woglumi* was found here with a very heavy infestation on a few Italian lemon trees only. The parasites found here were the same as those at Gauhati but the parasitization was much lower. In citrus groves, infestation by *A. woglumi* was less than one per cent and parasitization was 80 per cent. The hyperparasite, *Ablerus* sp. attacking all *A. woglumi* parasites, was very numerous here, about 50 per cent. In the rest of India it was never more than one per cent. In North India and Pakistan, it did not occur. A number of coccinellid predators was found here. One of them, apparently a new species on *A. woglumi*, was exceptionally numerous and effective but highly parasitized by a chalcid secondary, to 60 per cent.

Shillong.—Only *A. cameroni* was found here, in small numbers on citrus about one per cent. This was well parasitized by *Amitus* sp., possibly *hesperidum.*

In general, *A. woglumi* seems to be controlled by its parasites in all regions of India. The species of parasites vary in the different areas and one species may be dominant in one region (*P. clypealis* in Poona, Madras etc.) and minor in another (*P. clypealis* in North India, Assam). Several species of parasites occur in Assam but nowhere else in India. Only two parasites occur in all the regions, viz. *P. clypealis* and *Amitus hesperidum.* These two parasites have never been recorded previously as attacking *A. woglumi.*

A. husaini appears much more of a pest than *A. woglumi*, and in some years and certain regions, causes considerable damage to the crop as in Central Province and East Punjab. Only two species of parasites were reared from this pest. In Central Province and South India only one parasite occurred.

A. spiniferus was found in Southern India, only, from Bombay south. It occurred almost entirely on roses.

A. cameroni was found only at Shillong, on citrus only.

CAMPAIGN AGAINST GRASSHOPPERS IN BOMBAY STATE DURING 1949

Campaign against the Deccan wingless grasshopper (*Colemania sphenarioides*) a serious pest of jowar etc. and the Rice grasshopper (*Hieroglyphus banian*) was conducted in Bombay Province during 1949. The infestation of *Colemania* was very severe in the districts of Belgaum, Dharwar and Bijapur and to smaller degree in Nasik, Ahmednagar and Sangli. The infested area in these six districts is estimated at 1,50,000 acres, but in view of the various limitations, such as availability of insecticide, machines and trained hands, 53,624 acres only could be treated, Benzene hexachloride (BHC) dust was used and to be on the safer side, its strength was as high as 10 per cent. The rate of application varied from 15 to 25 lbs. per acre. The insecticide was supplied to the cultivator at a subsidized rate i.e. at one-third the cost price. All the dusting machines that were available under the Crop Protection Scheme were concentrated in Belgaum, Dharwar and Bijapur and were given on hire to the cultivators on a nominal charge. The Bombay Agricultural Pests and Diseases Act, 1947, was applied in these districts for a period of six

months, to ensure that infested fields do not remain untreated in the midst of dusted fields.

The main infestation of the Rice grasshopper was in the district of Belgaum. The infested paddy fields lay over an area of about 25,000 acres and were fortunately more or less a contiguous block. Control operations were carried out on about 23,000 acres which were more highly infested. The campaign was organised on the same lines as for *Colemania*, but Rice grasshopper being more susceptible to BHC poison, the strength of the dust used was only 5 per cent.

In the course of this campaign a total area of 76,645 acres (under jowar and paddy) was dusted, and it is estimated that the result is a saving of about 7,286 tons of cereals, valued at about Rs. 22,00,000. The approximate cost of the operations is Rs. 4,20,000. The district-wise figures for the campaign are as follows :—

District	Area proposed to be treated		Area actually covered		Estimated additional production of grain
	Jowar	Paddy	Jowar	Paddy	
	Acre	Acre	Acre	Acre	Tons
1. Belgaum	27,000	25,000	31,500	23,000	5,182
2. Bijapur	17,000	..	9,462	..	899
3. Dharwar	20,000	..	11,435	..	1,087
4. Sangli	6,000	..	908	..	86
5. Nasik	3,000	..	340	..	32
6. Ahmadnagar ..	2,000	..	..	..	..
	75,000	25,000	53,465	23,000	7,286 (valued at 22 lakhs).

Grasshoppers also infested sugarcane crop in Ahmednagar and Nasik districts. The infestation in Nasik district, was light and the damage is estimated at 2 per cent in an area of 100 acres. In Ahmednagar district the infested area was about 3,200 acres. Of these 1,832 acres were sprayed with crude oil emulsion and 450 acres were dusted with BHC. The infested fields were partly in factory areas and were treated effectively with the active help and technical advice of the State department of Agriculture.

(Prepared by the Deputy Director of Agriculture [Research and Education] Bombay State.)

PEST CONTROL WORK IN MADRAS DURING THE HALF YEAR ENDING DECEMBER, 1949

The following is a brief summary :—

I. *Paddy.*—The more serious pests dealt with were (i) the rice grasshopper—*Hieroglyphus banian*, (ii) the stem borer—*Schoenobius incertellus*, (ii) the army worm—*Spodoptera mauritia*, (iv) the leaf roller—*Cnaphalocrosis medinalis*, (v) the case worm—*Nymphula depunctalis*, (vi) the root grub—*Echinocnemus oryzae*, (vii) the rice Hispa—*Hispa armigera*, (viii) the leaf beetle—*Leptispa pygmaea*, (ix) the striped bug—*Tetroda histeroides*, (x) the rice bug—*Leptocorisa acuta*, (xi) the green jassid—*Nephotettix bipunctatus*, (xii) the mealy bug—*Ripersia oryzae*, (xiii) the gall fly—*Pachydiplosis oryzae* and field rats. At a very rough estimate, about 45 thousand acres of infested crop were treated and a saving of over six thousand tons of grain was effected.

Generally speaking the control measures adopted consisted of dusting and spraying the crop with insecticides. e.g., benzene hexachloride and DDT in different formulations, Calcium arsenic etc., using poison baits and of some mechanical and cultural methods. BHC dust 5 per cent (D.0.25) was, on the whole very effective in the control of grasshoppers (*H. banian* and *Oxya velox*), the army worm (*Spodoptera mauritia*), the rice bug, the leaf roller, and the leaf beetle. Dusting with DDT 5 per cent was found useful against the green jassid. The rice case worm was checked by mechanical methods as well as dusting. The application of phosphatic and other manures to stimulate the growth of crops was helpful in their withstanding the attack of some pests.

The major campaigns were against (i) the rice grasshopper, which infested the paddy crop very severely over an area of about 9,000 acres in several districts, e.g. Vizagapatam, Godavari, Krishna, Guntur, Kurnool, Bellary and Palghat. About 2.25 thousand acres of the infested crop was dusted with BHC (D.0.25) and the pest was controlled. Saving of grain in the northern zone was 340 tons valued at about Rs. 66,000 and in Malabar alone 320 tons of grain were saved. (ii) The green jassid broke out in the districts of Tiruchirapalli, Salem, Chinglepet and Arcot over about 1,500 acres and was dusted with DDT (5 per cent). In smaller areas 0.1 per cent solution of DDT was sprayed on the crop. The jassid was successfully controlled and a saving of over 120 tons of grain was effected. (iii) The striped bug was serious in the districts of Salem, Coimbatore, Tiruchirapalli and North Arcot. An area of about 700 acres was dusted with BHC (10 per cent) and a saving of over 72 tons of grain was effected. (iv) The rice bug which infested over 420 acres of crop in the districts of S. Kanara, Malabar, Ramnad, Salem, Nilgiris, Tinnevelly and Chinglepet etc. was controlled by dusting with BHC (5 per cent) and about 40 tons of grain was saved. (v) The rice case worm was serious in South Vizagapatam, Chittoor, Anantpur, Bellary, Krishna, South Kanara and Nilgiris over large areas. Spraying the crop with 0.1 per cent DDT solution dusting with BHC 5 per cent controlled the pest over an area of about 330 acres and gave an extra yield of over 20 tons of grain. (vi) The leaf beetle (*Leptispa pygmaea*), which was a bad pest of nursery paddy

in Malabar in Wynaad taluq on about 100 acres, was controlled by dusting Guesarol 25 or BHC (53) giving a saving of about 380 tons of grain. (vii) The rice hispa which is also a serious pest of nursery paddy in parts of South Kanara, Salem, and Tiruchirapalli districts, was controlled in an area of 104 acres by dusting the crop with BHC (5 per cent) and by clipping off the leaf tips containing the grubs of beetle. Top dressing with ammonium sulphate was also considered helpful in reducing the pest intensity. The treatments gave an extra yield of about 15 tons.

Rats.—The rats appeared to be a great menace to rice crop all over the State and affected about 29,000 acres of fields. Baiting with zinc phosphide was very effective resulting in a saving of about 4,000 tons of grains.

II. *Jowar, etc.*—Amongst the pests of millets the Phadka grasshopper—*Hieroglyphus nigrorepletus*, the wingless Deccan grasshopper—*Colemania sphenarioides* and the ragi cutworm—*Laphygma exigua*, the cholam ear bug—*Calocoris angustatus*, and the cholam mite—*Paratetranychus indicus* were found to be the serious enemies of the crop.

Phadka infested the crop in Rajampet, Udayagiri and Athmakur taluqas. It was checked by large scale dusting operations with BHC (5 per cent) over 2,000 acres of the crop. The saving of about 500 tons of grains was obtained. The wingless Deccan grasshopper which was serious in Bellary and Kurnool districts and infested mostly thanai, cumbu and Cholam crops was controlled by dusting BHC 10 per cent over 140 acres of the crop.

In Guntur, Nilgiris and South Vizagapatam, *Laphygma exigua* was controlled over 60 acres of the crop by hand-picking and dusting with BHC (5 per cent). The bug *Calocoris angustatus* infested the crop in Coimbatore, Ramnad, Salem and North Arcot districts. Early sowing of the Chitrai irrigated cholam reduced the incidence of the bug very considerably. Dusting with BHC over 42 acres was effective in controlling the bug. The cholam mite (*P. indicus*) infestation was found in about 20 acres in Guntur, Tinnevelli and Ramnad districts and was reduced by dusting the crop with sulphur (50 per cent.).

III. *Vegetables.*—The more serious pests were *Epilachna* spp. mealy bug (*Pseudococcus* sp.) the chilli thrips (*Scirtothrips dorsalis*) and *Agrotis* spp.

The brinial crop in Ramnad, Chinglepet, Coimbatore, Mathurai and Tinnevelli districts was attacked by *Epilachna* beetles seriously in 150 acres. The crop was saved by dusting it with calcium arsenate.

The chilli thrips were very widespread. About 1,750 acres were successfully treated by dusting with BHC (5 per cent) and spraying with tobacco decoction. Increase in the yield worth over two lakhs of rupees was brought about.

IV. *Sugarcane.*—The grasshopper *Hieroglyphus banian* was dusted over 25 acres with BHC (5 per cent) and as a result thereof an additional income of Rs. 4,800 was expected.

V. *Tobacco.*—The caterpillar—*Prodenia litura* is a serious pest in Guntur, Krishna, East Godavari districts. It infested 65 acres of the seedlings and 60 acres of the planted crop. Application of calcium arsenate dust or BHC 5 per cent yielded an additional income of Rs. 7.5 lakhs.

VI. *Oilseeds.*—Groundnut crop was infested with the red hairy caterpillar—*Amsacta albistriga,* over 500 acres in Ramnad, Chinglepet, Arcot and Salem districts. The castor plants were attacked by the semi-looper—*Achaea janata* in Guntur, Godavari and Anantpur districts. The former was controlled by hand picking and the latter by dusting with calcium arsenate.

IMPORTANCE AND CONTROL OF THE PESTS ATTACKING PADDY IN THE UNION OF TRAVANCORE AND COCHIN

In the Union of Travancore and Cochin three crops of paddy can be grown if irrigation facilities can be made available. First crop is served well by the South-West monsoon. Some failures occur in the second Paddy crop grown between October-January when the North-East monsoon is not satisfactory. The third paddy crop, 15th February-May, cannot, however, be grown without artificial irrigation facilities. To aid in the present drive to grow more food, a lift irrigation scheme to cover an area of 12,000 acres, has been launched at Alwaye, with the result that paddy crop is always found in the fields at one stage or the other and this has afforded ample chance for the multiplication of pests that attack paddy. Secondly continuous growing of paddy crops coupled with inadequate manuring, has resulted in crops that fall easy prey to even the minor pests. The result has been that the crop became heavily infested by pests in October 1949.

One of the Technical Officers of the Central Directorate of Plant Protection, Quarantine & Storage was deputed by the Plant Protection Adviser to the Government of India to demonstrate the methods of control of the pests attacking paddy at Alwaye in October. He camped there for a fortnight and reported that the pests doing largest amount of damage were (i) paddy Hispa (*Hispa armigera*) and (ii) rice case worm (*Nymphula depunctalis*) Both of them attack the crop in the young stage when it is about three weeks old in the field and are known to cause damage for about one month and a half. Noticeable damage by (iii) paddy stem borer (*Schoenobius incertellus*), (iv) paddy Leptispa (*Leptispa pygmaea*) and (v) paddy leaf roller (*Cnaphalocrosis mendinalis*) in some of the fields either alone or in conjunction with the above pests was also noted. The other pests known to be severe were the paddy bug (*Leptocorisa acuta*), and the swarming caterpillar (*Spodoptera mauritia*). The former is bad at the time of earing and the latter causes devastation to paddy nurseries.

Demonstrations of control measures were given against the paddy Hispa and the case worm in the villages of Velithunad, Eloor, Chewara, Matoor, Kaladi, Angamali and Changa Wanad covering an area of about 25 acres. The insecticide used was Gammexane

(D0.25) and it was dusted by means of both the power dusters and hand rotary blowers. As a result of dusting, Hispa beetles and moths of the Case Worm began to die after about half an hour but the larvae of the latter took about 24 hours to die. The ryots showed keen interest and willingly came forward to dust their fields with the hand blowers.

In the use of hand blowers, the Giant hand blowers (10 lbs. capacity) were found to be inconvenient and not so handy as the Craven rotary blowers (5 lbs. capacity). As the ryots have to dust and walk through the crop standing in water, they prefer to have light blowers.

As for the power dusters the heavy ones cannot be conveniently used in rice fields. Their performance in a large measure, depends upon favourable wind, otherwise the deposition of the dust is not uniform and results in greater waste of the insecticide. However various types of power dusters are being tested with the object of determining their suitability under Indian conditions and it is hoped that a suitable power duster would be recommended for work in paddy fields.

These demonstrations were visited by the Hon'ble Minister for Food and Agriculture, Government of India, accompanied by the Minister of Agriculture, Union of Travancore and Cochin on the 29th of October. These demonstrations were arranged with the help of the Director of Agriculture, Union of Travancore and Cochin and active co-operation of the Imperial Chemical Industries. The help of both is gratefully acknowledged.

PROGRESS OF MYCOLOGICAL WORK IN THE PUNJAB (I)

By C. S. Paracer,

Assistant Mycologist, Ferozepore

Gram Wilt.—Investigations have shown that subsoiling at proper time reduces gram wilt to a large extent. The method is economical and its effect lasts for several years. Gram, type G-24, has been found to be resistant to the disease.

Partial Bunt.—Partial Bunt of wheat due to *Neovossia indica* is very serious in several parts of the Punjab. The disease is air-borne and causes blossom infection. If there is sufficient rainfall and low temperature at the time of ear and grain formation, the incidence of the disease is very high. Efforts are being made at Gurdaspur and other places in the Punjab to secure varieties of wheat which resist this disease.

Flag Smut.—Flag smut of wheat due to *Urocystis tritici* is a serious trouble in several districts. Disinfecting the seed with powdered copper sulphate at two ounces for 10 to 15 lbs. has given the best results. Early and late sowings reduce incidence of the disease considerably. Several varieties have been found to be resistant and further trials are in progress.

Loose Smut of Barley.—This disease due to *Ustilago nuda* appeared in a very serious form in the Punjab. The hot water method reduces the germination of the seed under Punjab conditions by 70 per cent. Solar heat treatment has given, however, very useful results. This work is being carried out in the various farms of the Punjab Department of Agriculture.

Other problems.—Among the most important mycological problems that need to be taken up immediately in the Punjab is the "green ear" disease of bajra. Bajra is very important in the Punjab and occupies an area of 23 lakh acres. The green ear disease is getting more and more serious and threatens the very existence of the crop in certain localities. During 1949-50, certain varieties were wiped out by this disease. The malformation of mango inflorescence is also causing anxiety to the mango growers, as the disease is gradually spreading and doing much damage.

CONTROL OF MUSTARD SAWFLY (ATHALIA PROXIMA KLUG) IN AJMER-MERWARA

By Girdhari Lal Bhatia,

Assistant Entomologist

Among the various cruciferous crops, Cauliflower is grown over hundreds of acres in Ajmer State and is exported to Bombay, Ahmedabad etc. Seedlings of Cauliflower are ready by the middle of August and by the end of September cauliflowers are ready for export. Among the various insect pests that attack cauliflower Mustard sawfly (*Athalia proxima*) is the most serious. The insect appears almost immediately the cauliflower seeds start sprouting. The female thrusts eggs in the tissues of the leaves of the vegetable plants. The eggs are deposited only singly. The larvæ hatches out within about a week's time and eats out holes towards the edge and in the centre of the leaves. The young larvae is locally known as 'Kali lath'. The young larva is greenish grey in colour. As it grows it deepens in colour and appears greenish black when fully fed. The period of larval life varies between 12—35 days after which the larva bores into the ground, prepares cacoon in the soil and pupates. After 10 days of pupation the adult emerges. The female starts laying eggs after 3 or 4 days of emergence initiating a new generation and the damage is continued as stated above. The extent of damage by these larvae is sometimes enormous, completely skeletonising the leaves as a result of which the plant is so weakened that the crop is completely destroyed.

In view of the complaints received from the Cauliflower Growers Association about the destruction of the cauliflower by this pest it was decided to carry out control measures against this pest. Among the control methods already known the most commonly practised is hand-picking of the larvae and killing them in kerosened water or dusting the affected parts with some poison. The former method is a laborious one and the latter not very satisfactory. Light dusting of Benzene hexachloride (5 per cent) and suspension benzene hexachloride were tried on the seedlings. The light dusting of BHC (5 per cent) gave an effective control of the pest but a few larvae escaped the treatment because of the over-crowding of some of the

seedlings. BHC suspension was subsequently tried and the procedure followed was as mentioned below :—

First of all as many larvae as possible were dislodged from the seedlings on the soil. The seedlings were sprayed liberally with the above suspension prepared by mixing 2 oz. of 5 per cent Benzene hexachloride in about 2 gallons of water. In about two hours not a single living larva could be traced on the affected plants. Due to deposits of the above mixture, the seedlings became white. The next day the seedlings were sprinkled with water only to remove the white colour. They looked very healthy.

CAN PARASITIC FUNGI OVERCOME THE RESISTANCE OF HOST PLANTS DEVELOPED BY GENETIC MEANS ?

When control of plant diseases by the application of fungicides or by the modification of cultural practices is not possible, the help of the Plant Breeders is usually sought to discover disease-resistant varieties. Professor H. N. Hansen, Professor of Plant Pathology and Plant Pathologist at the California Agricultural Experiment Station states however that disease control achieved by genetic means is effective only for a time. He illustrates this by two examples from California Agriculture.

In the late twenties and early thirties, the cantaloupe growers in the Imperial Valley were greatly handicapped by a powdery mildew wnich in some years caused the loss of nearly half their crop. Since fungicidal treatment and modified cultural practices did not give adequate control, an intensive breeding programme was initiated that eventually resulted in the production of a highly resistant variety that was released to the growers in the mid-thirties. Within two years after release of the resistant variety, mildew reappeared on the supposedly resistant plants and increased to such an extent that during the following year fungicides and other non-genetic methods had to be used in order to produce a crop.

Upon investigation of this breakdown of resistance in the cantaloupe it was found that there were present in that state at least two parasitically distinct races of the mildew fungus and that resistance had been developed to only one of them.

Another example is that of the ornamental garden flower, the snapdragon, which had begun to lose popularity because of extensive damage by a highly virulent rust disease. The plant pathologists in California found a gene resistant to this fungus and introduced it into many horticultural varieties of snapdragon. Here again resistance appeared to breakdown within a couple of years and snapdragons became as badly infected as before. Investigation of this apparent breakdown of resistance revealed the presence of more than one physiologic race of the rust within the state.

The temporary nature of the resistance in the cantaloupes and snapdragons was apparently due not to a genetic breakdown in the host plants, but rather to genetic changes in their respective pathogens.

This does not mean that developing resistant varieties of crop plants to disease can be ruled out. In the Bombay State and in Madhya Pradesh, varieties of cotton have been developed which are resistant to the wilt disease even after a lapse of 10 to 15 years. But efforts so far made to develop varieties of sorghums (jowar) or bajra resistant to their respective smut diseases have not been successful. In the case of blast disease or the *Helminthosporium* disease of rice, resistant varieties have not yet been successfully evolved even though partial resistance has been induced in some of the varieties. In many cases new and biologically distinct races of the pathogens have arisen and all calculations regarding the resistance of certain varieties to those diseases have been upset. It, therefore, seems clear that for controlling diseases like blast and *Helminthosporium* of paddy, it is desirable that control by the application of fungicidal dusts or sprays or by the modification of cultural practices should not be lost sight of.

A NOTE ON THE RESULTS OF TRIALS WITH PLANOFIX FOR THE PREVENTION OF PRE-HARVEST FRUIT DROPS IN CITRUS

These trials were conducted at the Fruit Research Station, Kodur in September, 1949. Two trees in each of four citrus fruits viz., lime, lemon, pummelo and sweet orange which showed yearly pre-harvest fruit drops were taken up for the study. An equal number of fruits on separate limbs of each tree were utilized for the untreated controls and for treating with Planofix. Sprayings of this product in concentrations of 1 c.c. to a gallon of water (10 parts per million active "hormone" principle) were given to the fruits on each 'treatment' limb at weekly intervals on four occasions. On the expiry of another fortnight, a fifth spray was also given. The number of fruits borne on each of the limbs at the commencement of the trials and the fruit drops that occurred daily were recorded till all the fruits were harvested. A summary of the data collected is presented below :—

Variety	No. of fruits sprayed	No. of fruits that dropped	Percentage of fruit drop	No. of fruits on untreated controls	No. of fruits dropped	Percentage of fruit drop
Sweet orange ..	82	14	17·0	82	38	46·3
Acid lime	69	36	52·2	69	57	82·6
Lemon	23	1	4·3	23	7	30·4
Pummelo	22	1	4·5	22	3	13·6

It is seen from the above that spraying of fruit with Planofix has been of some assistance in reducing pre-harvest fruit drops in all the four citrus trees and more particularly in the case of acid lime, sweet orange and lemon.

(By Asst. Fruit Specialist, Kodur, Madras).

ON INSECTICIDES OF VEGETABLE ORIGIN AND POSSIBLE DIRECTIONS OF THEIR DEVELOPMENT AND APPLICATION IN INDIA

By S. Siddiqui,

Chemical Laboratories, Tibbia College Bldgs., Delhi

A realisation of the somewhat unequal struggle for survival between the insect world and the internally disrupted and divided house of man, loaded as the latter is with an incomprehensible urge for self-destruction, appears to be of a fairly recent origin. That such a formulation of the situation regarding the ultimate inheritance of the earth is not a matter of light hearted witticism, will be evident from the fact that the insect world far outweighs the human, weight for weight, carries disease and pestilence, destroys and eats up cultivated crops and stored food, causing losses assessable in almost astronomical figures. Due to a growing appreciation of the acuteness of this situation, increasingly greater organised efforts have been made since the beginning of the present century to fight back this aggression by the use of insecticides of mineral, plant and, comparatively more recently, of synthetic origins. In the course of this development, progressively greater efforts have been directed towards the substitution of highly toxic materials like arsenicals and silico fluorides with products of plant origin which are comparatively less toxic to man and animals.

In the search for plant insecticides, advantage has been taken of the fact that quite a number of plants, used by the indigenous populations of various countries for ages as fish poison, have been shown to possess insecticidal properties in varying degrees. While the volume of research, however based on this finding is truly colossal, the number of plants and plant constituents which it has been possible to establish as useful and economically practicable insecticides is strictly limited. Apart from pyrethrum, which on account of its non-toxicity to man and animals, and high knock-down value remains by far the most efficient and safe among all insecticides in use, others of commercial value are :—

(I) The alkaloidal plants :

(i) *Nicotiana rustica*, *Nicotiana tabacum*, as sources of Nicotine ; and

(ii) The anabasine bearing plants, *Anabasis aphylla*, indigenous to Russian Turkistan and neighbouring countries of Central Asia and *Nicotiana glauca* which grows wild in South West U.S.A.

(II) Rotenone bearing plants :

(i) Certain species of derris e.g. *Derris elliptica, Derris malaccensis, Derris trifoliata* (Ceylon), *Derris robusta,* and *Derris ferruginea ;*

(ii) Various species of *Lonchocarpus* (mainly South American countries).

I. Although extensive use of tobacco extracts has been made for the control of specific agricultural pests, it is difficult to obtain reliable figures for the production of tobacco extracts and of nicotine and nicotine sulphate in various countries. Pre-war figures indicate production of 1,000 long tons of nicotine sulphate in United States, 100 tons of nicotine in Germany, 100 tons of nicotine sulphate in Japan, and 735 tons of all categories of nicotine insecticides in U.K. The records are, however, silent about U.S.S.R., which none the less appears to be the most important among the producers of the two alkaloidal insecticides, with almost a monopoly of anabasine production, and the production of nicotine probably fairly comparable with that of the U.S.A. No such industry exists in India, and although farmers in the country have been advised by the Agricultural Departments in various provinces to prepare aqueous tobacco extracts for crop protection against insect pests, it is extremely doubtful if this good advice from a distance has been followed up to any record-worthy extent, by the resourceless and illiterate peasantry.

II. The use of derris roots is of comparatively recent origin, the chief producing countries before the world war II being in the order of importance Malaya, Indonesia, Philippines and Sarawak. They all grow almost exclusively *D. elliptica* and *D. malaccencis,* the production in 1938 being estimated at about 4,000 tons of the roots for Malaya. While many species of derris are indigenous to India, they have been found to be inactive with the exception of *D. ferruginea* which grows widely in Assam ; but this species also contains only 3 per cent of rotenone, a rather low figure for the active principle which, along with the percentage of the other extractive, forms the basis of commercial valuation of the derris roots. Considering the success, however, of experimental cultivation of *D. elliptica* and *D. malaccencis* in Mysore, and U.P., it will be reasonable to assume that serious efforts will be made to bring these species under cultivation in suitable climatic areas of the country, in sufficient quantities to meet the internal requirements and also for export trade.

Among the rotenone bearing plants there is a growing competition to derris from various *Lonchocarpus* species (e.g. *L. utilis, L. urucu, L. martinii, L. sylvestris*) inspite of their lower rotenone content, the comparative import figures for U.S.A. being 1,042 and 850 tons for *Derris and Lonchocarpus* respectively for 1938. While the present production of *Lonchocarpus* appears to be limited mainly to the South American countries, Columbia, Peru, Equador and Brazil, Malaya has shown sufficient promise for the acclimatisation of certain species of *Lonchocarpus,* and it should be worthwhile to study the possibility of its cultivation in similar climatic areas in India.

Pyrethrum.—Experimental cultivation of pyrethrum in India has shown that Assam, Mayurbhanj, Kodaikanal, and Kashmere, pro-

duce pyrethrum flowers with fairly high pyrethrin content, ranging from 1.4 per cent in case of Assam to 0.95 per cent for Kashmere, as against 1.3 per cent and 0.9 per cent for the flowers from Kenya and Japan respectively. The production figures for the Kashmere flowers started with 0.2 tons in 1940-41 and steadily increased to 79.2 tons in 1945-46. It appears, however, that there has been considerable decline in the cultivation of pyrethrum in Kashmere since then, on account partly of unsettled conditions in the area, but mainly due to the fact that no interest has been shown for its industrial exploitation, after the assurance of ready sales of pyrethrum products to the Government, for anti-malarial measure during the war, can no longer serve as an incentive to industry. It may on the other hand be contended, that the advent of synthetics like DDT and Benzene hexachloride has been chiefly responsible for this situation, but while there is certainly some truth in that contention, the health hazards of these highly toxic chlorinated compounds definitely rule out their use for all pest control, directly or indirectly connected with food ; and consequently pyrethrum products have every assurance of this specific sphere of utility in addition to that of its use in any rational scheme of anti-malarial measures.

In connection with toxicity considerations regarding the use of insecticides, referred to in the preceding paragraph, it will not be out of place at this stage to give a few relevant extracts from more recent reports from U.S.A., which deal with the health hazards of some synthetic insecticides :

Agricultural Chemicals Vol. IV. No. 1, *Jan.* 1949.—Charles W. Crawford, Commissioner, Food & Drug Administration emphasised the great responsibility which manufacturers and users of agricultural insecticides face in making show that the national food supply will not be contaminated, nor the national health endangered, by the application of hazardous insecticidal products of food stuffs. Too many products presenting toxicity problems have been rushed into manufacture and use, before being thoroughly tested. Every phase of the toxicity problem must be thoroughly investigated even though necessary research is expensive and time-consuming, before new insecticides are offered for use. He is further reported to have said that liver damage has been shown to result from DDT at levels lower than 7 parts per million.

Agricultural Chemicals, Vol. IV, No. 2 *Feb.* 1949.—Food and Drug Administration has stated that it has been clearly shown that DDT appears in the milk fat when DDT sprays are used in dairy compounds and on dairy cattle, or when fodder bearing residues is fed; DDT is a poison and its use under conditions which would contaminate milk—a food so universally used by infants and children—would be contrary to the Food, Drug and Cosmetic Act.

Various scientific publications emphasise that DDT or any other insecticide must be used "properly". Fruits and cereal crops should be treated long before harvest, with no more than recommended amount of poison. In milk shed areas the problem is more complex, for cows may eat fodder treated with insecticides and the compounds may be carried in milk. According to all reports milk producing farms and the dairy herds should not be dusted or sprayed with the compounds.

Agricultural Chemicals Vol, IV. No. 3, March, 1949.—(From reports of the Texas Entomological Soc.). There are three pesticides, benzene hexachloride, organic mercury and selenium compounds, which we will not knowingly accept in any detectable trace by flavor, odour or chemical determination. Final acceptance of all purchases of fruits and vegetables will be subject to our Laboratory analysis and approval.

Chemical and Engineering News. Vol. 27 *No.* 20, *May* 16, 1949.—Paul B. Dunbar, United States Food and Drug Commissioner, stated that widespread use of DDT since the war has exposed the public to small, continued intakes from many sources for long periods. How serious this hazard may be in terms of human damage is not known. Rats fed with one part per million of DDT will during their normal lifetime, store DDT in fat. Minimum but characteristic liver damage was noted in feeding five parts per million. Female dogs exposed to cumulative effects secrete DDT in their milk. Mother rats fed 50 parts per million or more of DDT produce smaller offsprings with fewer survivals than control animals. For toxicity studies, the F.D.A. assumes that similar results might occur with human beings.

Experiments conducted by the Bureau of Entomology and Plant Quarantine showed that milk from cattle which eat silage bearing DDT or cattle sprayed with it or cattle kept in barns where DDT is used, contains DDT. In view of recent toxicological data on the cumulative effects of small doses of DDT, the F.D.A. has had to revise its prior views that with proper precautions to protect the food from contamination, DDT was a safe insecticide to use in producing all types of foods. Since milk is a universal food and the principal food of babies and children, the F.D.A. will not set up a tolerance for DDT in milk. Fortunately there are alternative and less objectionable substitutes for use in milk production.

As against these warnings, there is at the same time a considerable body of scientific opinion which considers a "proper" use of DDT within the limits of tolerance as quite harmless, and all this fuss about health hazards as rather 'hysterical'. Assessing the pros and cons of the whole controversy, however, and considering further that such a 'proper' use of highly toxic synthetic insecticides is likely to be somewhat more precarious and difficult of achievement in the present state of agricultural and dairy organisation in India than in U.S.A., it will be certainly more advisible to err on the side of caution, as recommended and advocated in the extracts of scientific reports cited above.

In view of the facts stated in the preceding paragraphs of this note, it would appear reasonable that in all pesticidal measures in India we should concentrate on the development and uses of insecticides of vegetable origin, limiting the use of synthetics to the barest practicable minimum. As already suggested in this note, serious concentrated efforts should be made for the cultivation of pyrethrum and other well established insecticidal plants and standardisation of their extracts and preparations on the one hand, and industrial utilisation of tobacco waste for the manufacture of standardised extracts as well as nicotine and nicotine sulphate, on the other.

While limiting attention to the use of these well established plant insecticides, a large amount of investigation can be carried out and should be carried out for evolving the best possible modes of application of the insecticides, as the manner of application is known to have profound influence on their effectiveness. For instance, the phenomena of synergism in respect of various insecticides needs a thorough and comprehensive study. Further, the particle size of the active principles in sprays and their wetting and spreading properties are of enormous importance in extending the usefulness of insecticides, and there is considerable room for research in this direction. A brief reference to some instances of the work carried out in the Chemical Laboratories of the Council of Scientific & Industrial Research may not be out of place in this connection :

(1) An emulsifier was evolved during the war for the production of biologically stable emulsion sprays from pyrethrum extracts, which when tested by the Malaria Institute were found to retain their activity for about a whole year, as against the usual soap emulsions of pyrethrum extracts which deteriorate in their activity within 36 hours. As ascertained through systematic Laboratory and field work by the Malaria Institute, this emulsifier did not only stabilise the pyrethrins in emulsion sprays but also activated them to such an extent, that sprays with only 0.025 per cent of pyrethrins gave mosquito kills achieved with 0.1 per cent, in case of kerosine solutions of pyrethrum extracts.

(2) By employing stable mixture of solvents easily available in India, it has been possible to get higher concentrates of pyrethrum varying from 10—12 per cent, according to the pyrethrin content of the flowers being 1—1.2 per cent. The process was recently demonstrated to a chemist from Kashmir sent to the Chemical Laboratories of the Council, by Sir R. N. Chopra. The pyrethrum concentrate obtained by him with this process from stocked Kashmir flowers was, however, found to be only 4 per cent, but then in this case the flowers used assayed for only 0.4 per cent. pyrethrins owing apparently to their deterioration through long storage.

(3) Studies in the stabilising action of bhilawan and cashew shell liquids and products derived from them on pyrethrum extracts and products has definitely shown that sulfonated bhilawanol is a cheap and invaluable antioxidant for these products.

(4) A biologically stable mosquito-repellant semi-vanishing pyrethrum cream was formulated, which fulfilled all the requirements stipulated by the Malaria Institute during the war.

(5) On a reference from the Malaria Institute, an emulsifier was evolved for the production of emulsion sprays from DDT which were stable over long periods. DDT emulsion sprays produced with this emulsifier, which was principally based on the use of oleoresin in its formulation, conformed to all the specification tests needed of such emulsions. Nearly a year ago one gallon samples of 30 per cent solutions of DDT containing the emulsifier were sent to Agricultural Testing Centres, but the results are still awaited.

While all this has been done and some of the processes referred to were actually patented and used with great advantage during the war, none of them have been taken up for exploitation by the industry under peace conditions. On the other hand, the fruitful collaboration between the Malaria Institute and the Chemical Laboratories of the Council, which was mainly responsible for all this development during the war, also gradually waned off in peace time. This was particularly unfortunate, because it is only through collaboration of this kind between the chemists and the entomologist, that we can at all get to any worthwhile results in the field of investigations on plant or synthetic insecticides.

Another line of work, which was being followed in the Chemical Laboratories till recently, was directed towards the study of the products of chlorination and nitration derived from Bhilawanol and cashew shell liquids, the principal constituents of which are hydroxy benzene derivatives with straight unsaturated $C_{15}H_{27}$ side chains. Like chlorinated turpenes and some nitrated phenols, these products also appeared to give promising results, but for various reasons over which the investigators had no control, this work had to come to a sudden stop. It appears, however, that other Laboratories might take up this work with advantage, as these products are based on indigenous raw materials in the production of which India holds a virtual monopoly, and they may have some application in specific cases, where other plant insecticides are for some reason or the other not effective or practicable.

Notwithstanding the fact that most of the work on insecticides during nearly the whole of the last decade has been directed towards the synthetic field, quite a considerable amount of investigation still continues to be carried out on insecticidal plants, particularly with reference to the comparative toxicity of the botanical and synthetic insecticides. While in the present note emphasis has been laid on investigations and development of the commercially well established plant insecticides, it is by no means suggested that work at various research centres in India on the search for new insecticides of vegetable origin or even synthetics should receive no attention. What is claimed is that in the present situation, faced as we particularly are with the paucity of research personnel and difficulties in the way of collaboration between chemists and entomologists, it will be advisable to work within these limitations and throw the whole weight of our organised effort on research cultivation and development of the well established plant insecticides, in the light of facts and recommendations embodied in this note.

NATIONAL & INTERNATIONAL REPORTING SERVICE

Extract from FAOs Publication No. C 49/15, dated 17th October, 1949. National and International Reporting Services on Animal Diseases, Plant Diseases and Insect Pests, FAO Conference Fifth Session, 21st November, 1949.

Plant Diseases and Insect Pests.

1. *National Legislation.*—In 17 countries, Governments are empowered by legislation to require growers to report the occurrence of crop diseases and outbreaks of insect pests. In other countries reporting by the growers is entirely voluntary. In practice, however, the legislative authority is exercised only in case of certain dangerous diseases of specific crops or insect pests which are of economic importance in that country. For example, the only diseases officially notifiable in England and Wales are the Wart disease of potatoes and Verticillium wilt of hops although under the Destructive Insects and Pests Acts, additions can be made to the list as and when it is deemed advisable. It is necessary that the number of notifiable diseases be limited as much as possible, because of the difficulty of recognising and identifying plant diseases and insects by laymen.

2. *National Reporting Service.*—The organization responsible for plant disease and insect surveys varies a great deal among countries. Ethiopia has no such organization. In Iceland, the staff consists of only one Entomologist and one Plant Pathologist. On the other hand, countries such as Canada, United Kingdom, and the U.S.A., are equipped with a large number of experts who carry out surveys along with their other duties. In most countries, the centre of coordination for reporting services is a special agency in the Ministry or Department of Agriculture. The surveys are made by the regular staff, who in most cases carry out other work as well, and by collaborators. The reports are assembled and summarised for release by a central agency.

In most countries, the persons engaged in surveys are college graduates with field experience of additional special training. In some countries, however, reports of the incidence of diseases and insects are made by general agricultural or horticultural officers who have no special training in plant pathology or entomology. In general, the degree of development in plant protection work in any country reflects the standard of training of the personnel conducting the reporting service.

3. *Records, Reports and Publications.*—Although 21 countries indicate that they have published records on the occurrence, distribution and prevalence of plant diseases and insects, those publications appear to be very different, varying from a popular account of common diseases and insects to detailed monthly reports. Periodic reports are issued by Canada, Denmark, Egypt, United Kingdom and the U.S.A. In several other countries, such records are incorporated in general agricultural reports. Occasional papers on the incidence of plant diseases and insects appearing in technical journals constitute the chief source of such information in most countries. Reasonably complete lists or reports on plant diseases, fungi or insects have been published in a number of countries, but again it is difficult to evaluate them on the same basis. Some are merely compilations of records in old literature, hence their reliability is questionable. Others may be based on the results of actual recent surveys and are sufficient to provide a general picture on the prevalence and distribution of plant pests in the countries concerned.

Sixteen countries replying to the questionnaire maintain records of diseases and insects intercepted from imported plant materials Since the correct identification of diseases and insects require a large number of specialists with expert knowledge and broad training, it is doubtful that such records in most countries are reliable.

4. *Adequacy of International Reporting.*—Apparently there is no special provision for the exchange of information on the incidence of plant diseases or harmful insect pests between Member countries of FAO, except in so far as this is accomplished by exchange of published reports. The International Institute of Agriculture in Rome published the "International Bulletin of Plant Protection", now discontinued, which contained some information on the incidence of plant diseases and insect pests. The contributions to this periodical, however, consisted mainly of papers reporting limited and unconnected observations by individual workers. The Commonwealth Mycological Institute in London is considering publishing a journal of current information on the occurrence of plant diseases within the British Commonwealth, but the present financial condition of the Institute precludes carrying out such a plan for the time being.

From the foregoing it must be concluded that no effective international reporting service on plant diseases and insect pests exists at the present time.

5. *Need for World Reporting Service.*—All replies to the questionnaire on plant diseases and insect pests emphasized the value of a centralised world reporting service. Without such a service there is constant danger of introducing or spreading plant diseases and pests that cause enormous losses. This danger is now greatly increased by modern transportation facilities and the growing trend towards introducing new and improved varieties of crop plants. Lack of information as to the distribution and prevalence of harmful insects and diseases makes it very difficult not only for the country concerned to institute adequate control measures, but for other countries to apply effective quarantine regulations. If a government desires, for example, to prevent the entry of the downy mildew disease or leaf smut of rice, the effectiveness of a quarantine will depend on knowledge of the distribution of these diseases outside the country.

There is at present considerable interest in regional international conventions for the adoption of uniform plant quarantine regulations. Such a convention has recently been approved in Africa and another is in prospect in Asia. FAO has made a general survey of quarantine regulations, which showed that they are lacking particularly in under-developed countries. Some have no regulatory legislation at all, others have some regulations but no enforcement, and still others have legislation inadequately drawn or unsound. An essential step in establishing agreements like those now proposed is a world reporting service covering the incidence of diseases and insect pests of economic importance and outbreaks of disease or infestation in previously free areas.

6. *Development of a Centralized Reporting Service.*—The development of a central world reporting service on plant diseases and insect pests would involve agreement between the member governments of FAO on several matters involved in the scheme including the following :

(a) Nature and frequency of reports.
(b) General instructions as to coverage.
(c) Standardization of procedures.
(d) Nature and extent of participation by member countries.
(e) Specific responsibilities of the Central office.

As in the case of a world-wide reporting service for animal diseases the usefulness of this service would mainly depend upon the efficiency of the national surveys. At first the coverage would have many limitations, due to the fact that many countries are equipped to participate in only a limited way, but the service would at once become available to all countries.

An essential feature in the development of a world reporting service would be an effort to improve the efficiency of the reporting service within each country. It would be a special function of the central reporting office to assist member countries in raising the standard of their methods and the results of their work to a satisfactory level. The extent of member country participation will inevitably be reflected in the coverage which is attainable. Participation by member countries cannot be greater than the number of qualified personnel and the type of organization which each country will permit.

A world reporting service for plant diseases and insect pests is an undertaking of considerable magnitude. While it may be advisable to make a modest beginning, provision should be made at the outset for a rapid expansion, since the system can only function satisfactorily if the coverage and the thoroughness of the reporting are sufficient. This, of course, involves financial considerations. It is estimated that the initial annual cost would be at least $50,000,00 and that eventually the budget would be about $100,000,00 or 2 per cent of the present budget of FAO.

NOTES

Readers of the *Plant Protection Bulletin* will be interested to know the answer given by Dean William H. Martin, Director of the New Jersey Agricultural Experiment Station, U.S.A., to a very common question which is asked by farmers :—

Q.—"Is there any value in applying fungicides to tomatoes when late blight is not a serious problem ?"

Ans.—"Yes. In 1947 when late blight was not serious in most tomato fields in New Jersey, results obtained from a commercial field test showed that control of late blight is not the only benefit derived from applying fungicides. A five-application spray schedule using 'Zerlate' fungicide at the first, third, and fifth applications and a fixed copper at the second and fourth applications controlled

not only late blight but also anthracnose and miscellaneous fruit rots. The percentages of diseased fruits on the treated and check plots were for late blight, 1 and 12.5; for anthracnose, 9.7 and 28.7; for miscellaneous rots, 5.3 and 13.4 respectively. Only 5.5 per cent. of all the fruits harvested from the treated plot were discarded as culls due to disease, whereas over 24 per cent. of the fruits from the check plot were discarded. The treated plot yielded 20.5 tons per acre of marketable fruit compared with only 13.1 tons per acre from the checks. Furthermore, because of control of miscellaneous foliage diseases, the quality of the marketable fruit from the treated plots was far superior to that of the fruit from the checks".

(Abs. from *Science and the Land*—the 1947-48 report of the N. J. Agri. Expt. Station).

U.S. KEEPS CONSTANT WATCH TO KEEP OUT AFRICAN SNAIL

Washington, March 8.—The United States welcomes visitors from many lands, but not the giant African snail. Being voracious eaters and extremely prolific, they are considered a potential menace to agriculture. A constant watch is kept to keep them out.

The giant African snail has succeeded in travelling half way around the world from its original home on the island of Madagascar and the southern and eastern coasts of the African mainland. Its first move was to India, when a collector brought a few specimens there in 1847. Multiplying rapidly, the snail advanced to Malaya, Singapore, Southern China, Indonesia, Thailand, and recently appeared in Hawaii.

They have not become pronounced menaces at their point of origin and in some other parts of the world, largely because they have been used as human food. But in countries where they are not eaten, they are not wanted because they destroy crops.

At present, about the only way to combat them effectively is to keep them from entering a country. This is because the giant snail, which has a set of 80,000 tiny teeth and a shell much larger than a man's fist, survives adverse conditions and reproduces itself rapidly. According to the U.S. Department of Agriculture, it is conservatively estimated that a single snail could be responsible for a population of nearly 11,000,000,000 snails within a five year period.

The snail's travels around the world are of immediate interest to the United States. Thousands of tons of salvaged war materials are being returned to the United States from Pacific areas, and the snails sometimes attach themselves to the materials being shipped. Importers and exporters are co-operating with the U.S. Bureau of Entomology and Plant Quarantine to prevent their entrance into the United States. So far, the bureau reports, they have been successful.—USIS.

SAFE DDT

For those who would like to use DDT but are afraid of being poisoned by it, the current Mosquito News (published by the American Mosquito Control Association) has a word of reassurance. According to Lieut. Commander William J. Perry and Lieut. Leonard J. Bodenlos of the Medical Corps, U.S. Navy, DDT is practically harmless to humans who get it on their skins or breathe it into their lungs.

The two officers examined military personnel and labourers who had been working with DDT for as long as five years. In no case did they find an ailment traceable to DDT. To make doubly sure, they analysed body fat from 16 men who had been exposed constantly to D.D.T. Though the insecticide tends to concentrate in fatty tissues, they found none of it in their samples.

Like many other things, DDT is poisonous to human beings if swallowed in large doses. Perry and Bodenlos suspect, however, that some of the deaths credited to DDT were really due to the kerosene and other solvents in which the insecticide was dissolved.

(An extract from the weekly News Magazine "Time" of April 24, 1950.)

RECENT PLANT QUARANTINE IMPORT RESTRICTIONS IN FOREIGN COUNTRIES

Belgium.—Importation of grape vines into Belgium is prohibited. Irish potatoes may only be imported if certified to have been grown in a region free from wart disease (*Synchytrium endobioticum*).

Holland.—Gooseberry plants may be imported through specified ports only if found free from the American gooseberry mildew (*Sphaerotheca mors-uvae*). Importation of Irish potato needs freedom from wart disease (*Synchytrium endobioticum*) as under previous rules.

Tasmania.—According to a recent notification, the importation of hops (commercial products of the hop plant) into Tasmania is prohibited except from countries known to be free from hop mosaic virus and downy mildew of hops (*Pseudoperonospora humuli*).

OBITUARY NOTICE

Dr. K. C. Mehta, M.Sc., Ph.D., (Cantab), Sc.D. (Cantab.), F.N.I.

With the passing away of Dr. Karam Chand Mehta on April 8, 1950 India has lost one of its pioneer Plant Pathologists. Born in 1891, he took his M.Sc. from the Punjab University where he studied under Professor S. R. Kashyap. Later he proceeded to the Cambridge University where he took his Ph.D. degree under the guidance of Professor F. T. Brooks. He joined Agra College, Agra, in 1916 as a Professor of Botany and became the Principal of that College in 1941. Besides his duties as a professor, he carried out extensive researches on cereal rusts which extended over a period of

30 years and his work will ever remain monumental in the history of Indian Phytopathology. Both in India and abroad he earned his due recognition. Early in 1929 he was elected the President of the Botanical section of the Indian Science Congress and represented India at the International Botanical Congress held at Cambridge in 1930. He was elected a foundation fellow of the National Institute of Sciences and was awarded the Sc.D. degree of the Cambridge University in 1941.

Dr. Mehta was an inspiring teacher, a zealous worker and a leader in the cause of Science. His death will be mourned all over the country by his students, colleagues and friends alike.

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